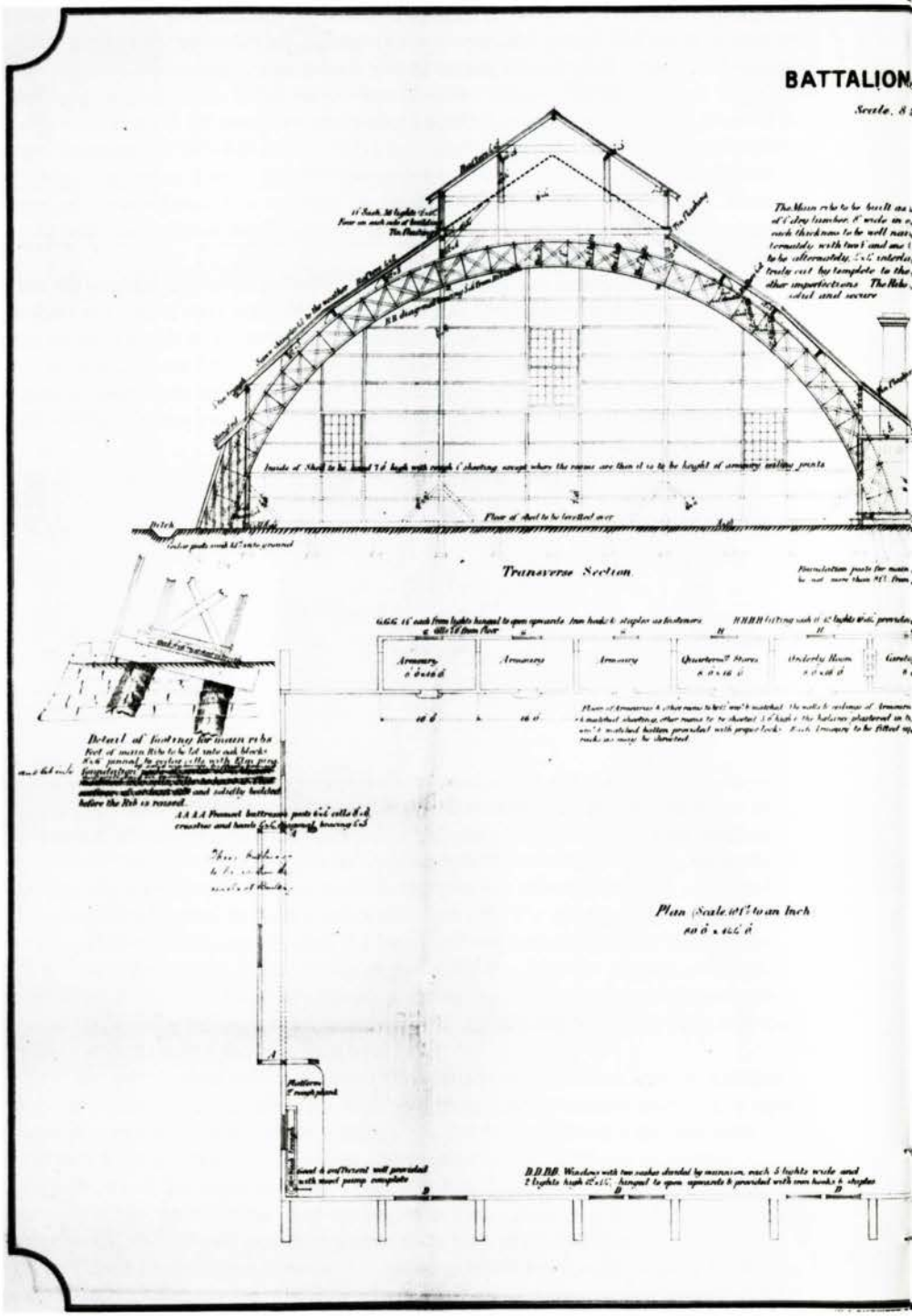
THE STRUCTURAL EARLY DRILL

In August 1866, a concerned officer of the Toronto Militia wrote to headquarters in Ottawa suggesting that the Department of Militia and Defence provide a standard plan of a drill shed which could be quickly erected at battalion headquarters across the province. He enclosed a plan, together with the estimated building costs. Within six months standard plans for drill halls of three different sizes were issued to all military headquarters.



DESIGN OF THE SHEDS IN CANADA

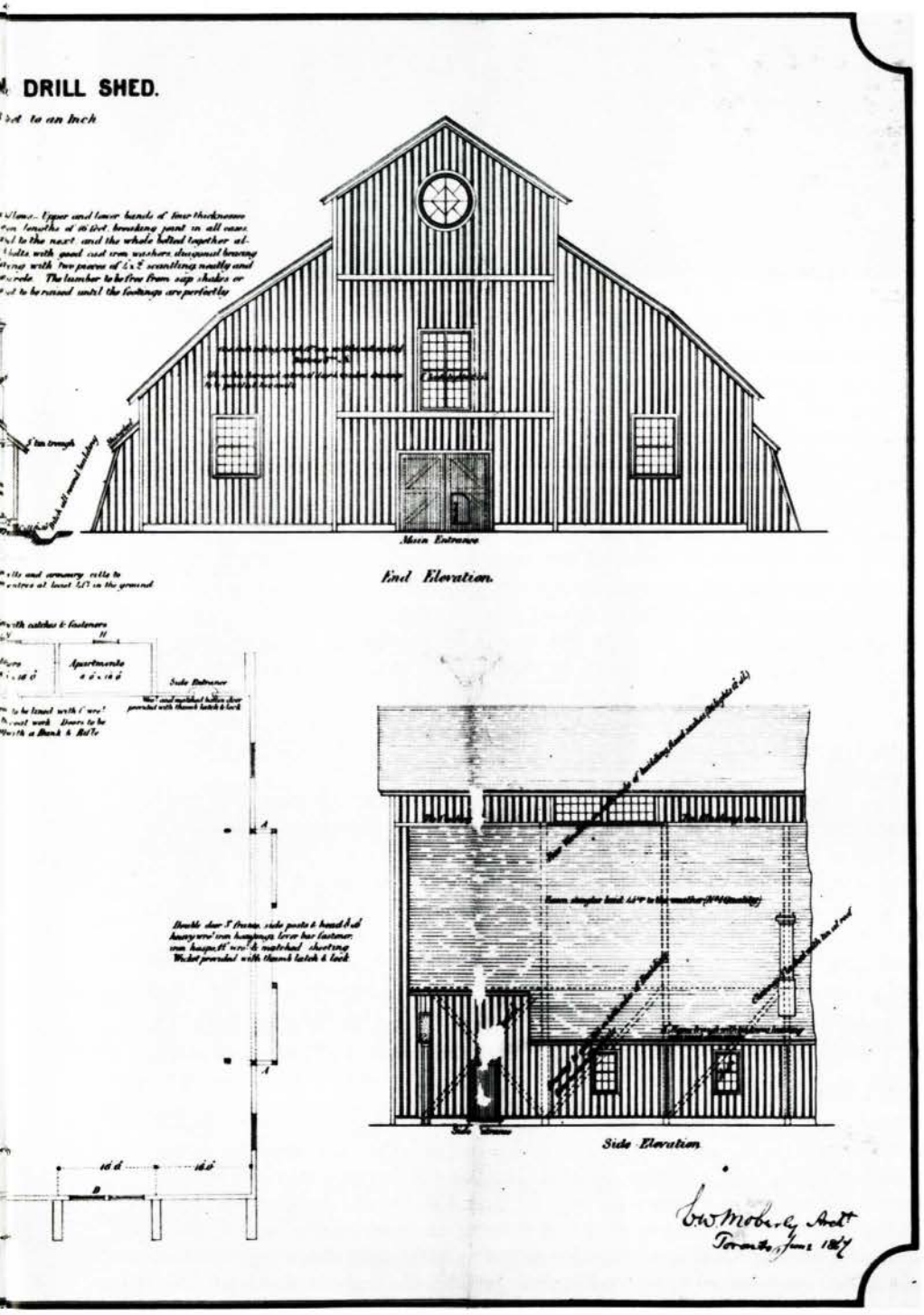


Figure 2. Revised standard plan for battalion sheds, signed and dated C.W. Moberly, Toronto, June 1867. (National Archives, RG 9, 11B2, Vol. 2, Files 1-10)

by Jackie Adell

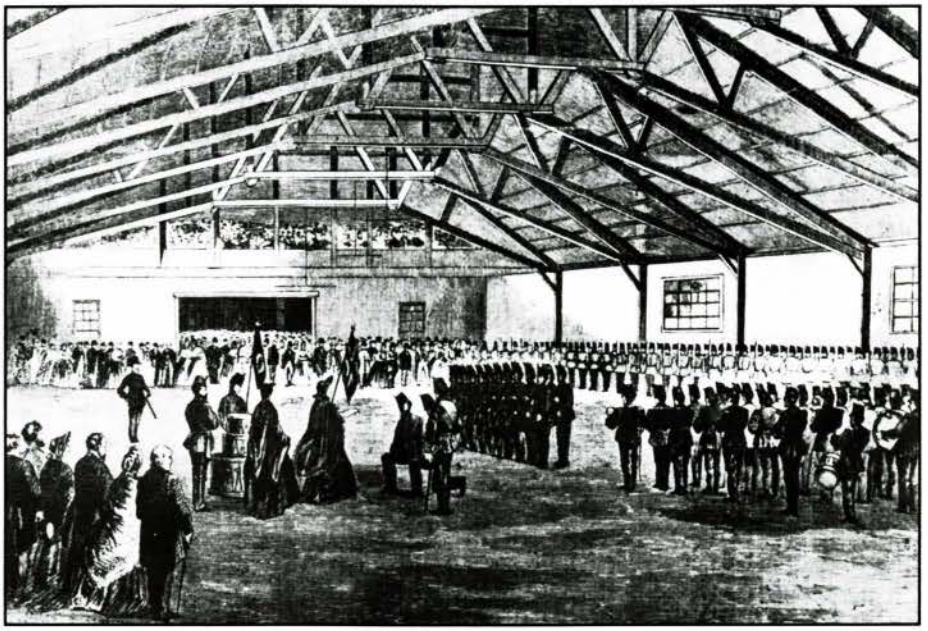


Figure 1. Presentation of the colours to the 13th Battalion in the Hamilton Drill Shed, 1863. (The Canadian Illustrated News *[Hamilton], 12 September 1863)*

"It was part of an exciting period when the covering of great spaces without intermediate supports stirred the imagination of architects and engineers in Europe and America."

Eric Arthur, Toronto: No Mean City

Even at their best, drill sheds, or drill halls as the militia buildings came to be known, are not handsome structures. Built to provide two basic militia requirements, a place in which to drill and secure dry armouries, they are often unwieldy-looking buildings that seem to take up more than their fair share of the urban space. Moreover, drill halls lack the sense of romance attached to other historic military structures and consequently they no longer capture the public imagination. Yet in the 19th century, the unencumbered covered space needed for drilling the militia presented the engineers with an interesting challenge. Their experimental efforts to accomplish the task extended over an 30-year period, beginning with the first temporary drill sheds of the 1860s and ending with the fully-realized drill halls of the 1890s. Tracing this phenomenon provides a small but useful insight into the early history of engineering in Canada, a subject which has yet to be fully documented.

The large drill hall is a 19th century building type whose drill space could only be contemplated because of the rapid advances in the design of engineering trusses in the middle years of the century, and the related introduction of first iron and then steel. In Britain and France structural cast iron had been used from the late 18th century onwards for bridges, factories, train sheds, and exhibition buildings, and by the 1850s it had become relatively common.[1] In the Province of Canada, however, the material remained scarce and expensive until well into the third quarter of the century and, with rare exceptions, all-metal roof trusses did not appear in buildings before the 1880s.[2] The builders of the first drill sheds worked with wood, and in lieu of the traditional heavy timber truss they adapted the new engineering trusses to their needs.

DRILL SHEDS OF THE 1860s

In 1862, prompted by a fear that the American Civil War could spill over the border, the government of the Province of Canada decided to reorganize and strengthen the Active Volunteer Militia.[3] Militia training consisted of regular drill exercises and target practice. Initially, this training took place in the open air, but it soon became apparent that the companies needed an indoor place in which to drill during the winter months. As well, since many volunteers, particularly city residents, were obliged to drill at night after a day's work, a dry, well-lit shed was identified by many commanding officers as a year-round necessity.[4] In 1863, therefore, the better-off regiments of Toronto, London, and Hamilton constructed drill sheds at their own expense, while the Department of Public Works built a fourth shed at Québec.[5]

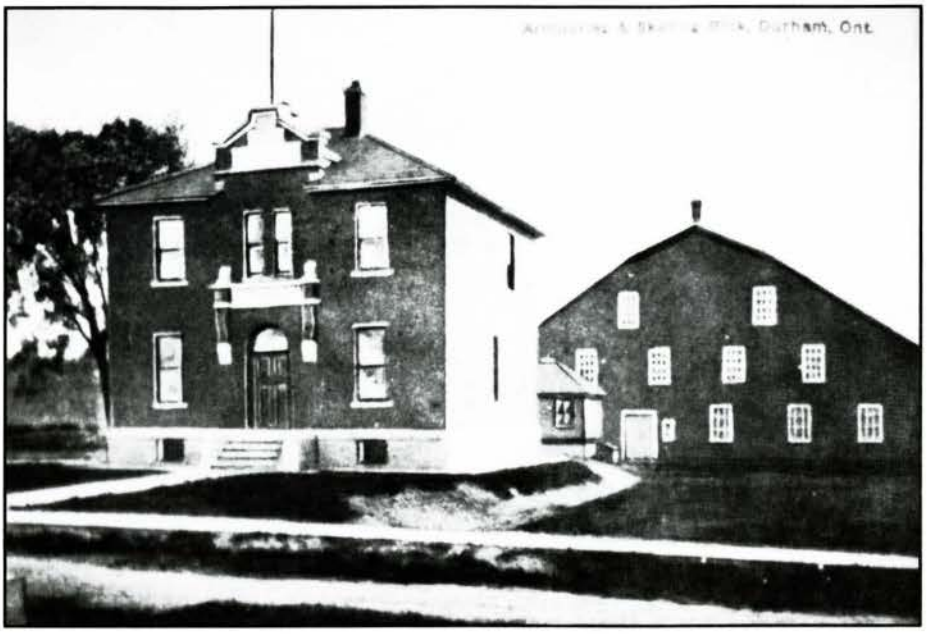
1 There are many published works on the history of structural iron in Europe. Two informative sources are: Frances H. Steiner, *French Iron Architecture* (Ann Arbor, Michigan: U.M.I. Research Press, 1984); and S.B. Hamilton, "Building Materials and Techniques," *A History of Technology,* ed. Charles Singer, E.J. Holmyard, A.R. Hall, and Trevor I. Williams (Oxford: Claradon Press, 1958).

2 Very little has been written on the early history of engineering in Canada. For the late 19th century, see Norman Ball, *"Mind, Heart and Vision," Professional Engineering in Canada, 1887-1987* (Ottawa: National Museum of Science and Technology, National Museums of Canada, 1987). The chapter on cast iron in Eric Arthur, *Toronto: No Mean City* (University of Toronto Press: Toronto, Buffalo, London, 1974) is useful for some key dates.

3 Kingsley Brown Sr, Kingsley Brown Jr, and Brereton Greenhous, *Semper Paratus: The History of the Royal Hamilton Light Infantry (Wentworth Regiment) 1862-1977* (Hamilton: The Royal Hamilton Light Infantry Historical Association, 1977) (hereafter cited as *Semper Paratus*), 11.

4 *General Report of the State of the Militia for the Province of Canada for the Year 1867* (Ottawa: Hunter Ross and Company, 1868) (hereafter cited as *Department of Militia and Defence* and the year of the report).

5 *General Report of the Department of Public Works for the year 1868* (Ottawa: Queen's Printer, 1869) (hereafter cited as *Department of Public Works* and the year of the report).



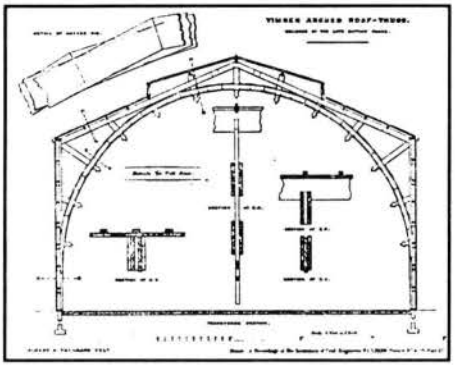


Figure 3 (above). Fowke's laminated timber arch roof truss. (John Weiler, "The Royal Engineers and the Development of Building Technology in the 19th Century," 307)

Figure 4 (left). The Duram Drill Shed (right), erected c. 1867. It was converted to a skating rink in 1910 when the new armoury (to the left) was opened. (Ian Bowering)

Of the four, the Hamilton shed is the best documented (**figure 1** and **cover**). It was a single-storey, rough board-and-batten structure with a gable roof. Its plan was little more than a large unobstructed hall measuring 75 feet wide by 200 feet long. There was a viewing gallery above the troop door and an officers' room and a guard room in a partial basement beneath the hall. The drill shed was lit by gas light. The building was designed by Alexander Askin, a railway engineer.[6] To roof the building, Askin used an adapted Fink truss, which had been developed in 1857 by Albert Fink, the famous American railway engineer.[7] Each truss consisted of two rigid triangles joined by a tie-bar, which was raised above the line of springing to permit an unobstructed view of the drill floor from the gallery. The trusses were supported by posts positioned along the lateral walls.

As it happened, Canada had nothing to fear from the American Civil War, but in the aftermath of that war the threatening activities of the Fenian Brotherhood made the need for well-equipped drill sheds and armouries for all units a matter of urgency. In the heat of the moment, thirty thousand Snider-Enfield rifles had been purchased and distributed to the volunteer corps in localities most exposed to a possible attack. Unfortunately, the majority of these units lacked proper armouries and drill sheds.

In August 1866, a concerned officer of the Toronto Militia wrote to headquarters in Ottawa suggesting that the Department of Militia and Defence provide a standard plan of a drill shed which could be quickly erected at battalion headquarters across the province. He enclosed a plan, together with the estimated building costs, and suggested that communities could be persuaded to erect the sheds if the department agreed to cover half the building costs (**figure 2**).[8] Within six months standard plans for drill halls of three different sizes were issued to all military headquarters.[9] Of the more than 100 structures erected to these plans, 21 were large battalion sheds.

The plans were prepared free of charge by Walter Moberly, the well-known engineer whose fame is today associated with the construction of the Canadian Pacific Railway. In 1866 Moberly was in Toronto working for the Northern Railway of Canada.[10] His plan for the battalion shed called for a wooden building measuring 144 feet by 80 feet with a clear height of 35 feet. Along one side of the building was a row of seven small rooms for use as armouries, quartermaster stores, and caretaker's quarters.

The novelty of the design was its roof structure. The roof was supported by an untied, semi-circular, laminated-wood truss whose upper and lower chords were set into oak blocks and pinned at ground level to cedar sills. Moberly explained his choice in a letter accompanying the design:

> At your request I have prepared the accompanying design for the drill sheds proposed to be built throughout the country. I have shown 2 designs for a roof—No. 1 although more costly I consider infinitely preferable in as much as it will give an appearance of greater height to the building and will be more pleasing to the eye, moreover as it is entirely constructed of small scantling of ordinary dimensions, it will be easy to get it of seasoned stuff. Whereas in Design

6 *Semper Paratus*, 13, and National Archives, RG9, 1C8, Vol. 12, Barracks and Drill Sheds, 1866-67, "Hamilton Armoury and Drill Shed."

7 Carl W. Condit, *American Building Materials and Techniques from the First Colonial Settlements to the Present* (Chicago and London: The University of Chicago Press, 1968), 142-43.

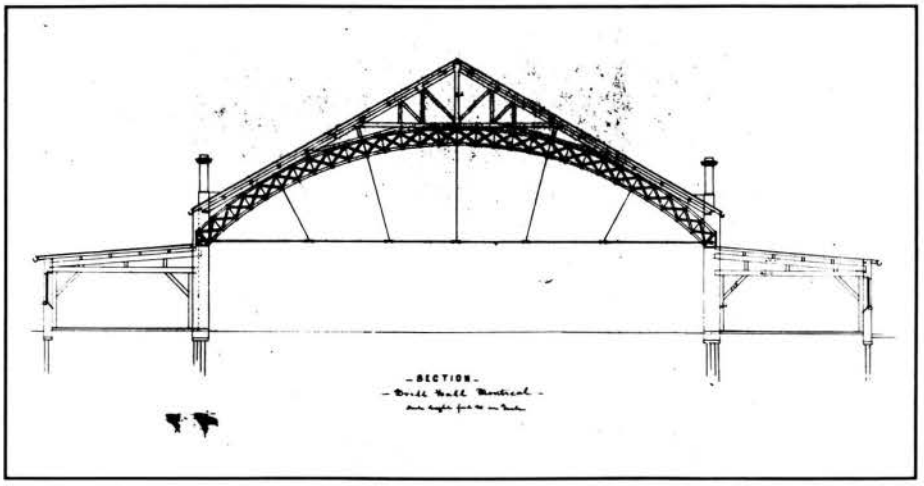
8 National Archives, RG9, 1C8, Vol. 2, Lt. Col. Durie to Col. Macdonald, 3 August 1866.

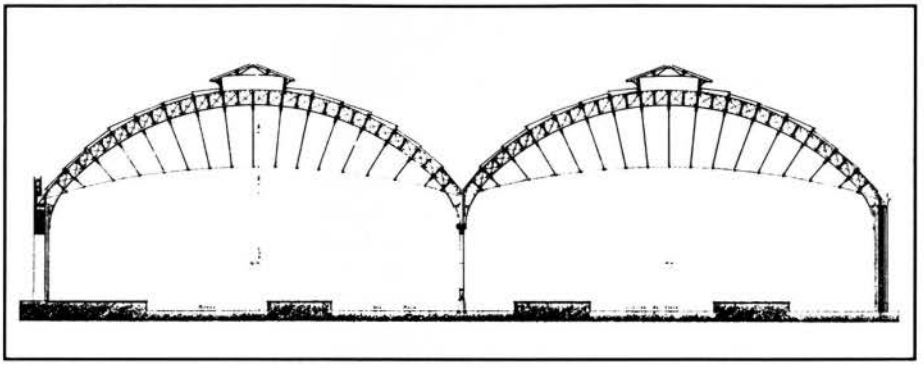
9 National Archives, RG9, 11B2, No. 103, circular relating to the Grant of Public Money in aid of the Erection of Drill Sheds, December 1866.

10 National Archives, RG9, 1C8, Vol. 2, C. W. Moberly to Lt. Col. Durie, 2 August 1866.

Figure 5 (top). Section through the Craig Street Drill Hall, Montreal, dated 16 February 1870. (National Archives, RG9, 11B2, Vol. 30)

Fifure 6 (bottom). Section through the train shed, Victoria Station, London. Robert J. Hood, engineer, 1859-66.





No. 2 the timber must necessarily be larger and in long lengths consequently it will be very difficult and sometimes impossible to get it seasoned.[11]

By far the most celebrated example of this lattice-arched truss was the great train shed at St. Pancras Station in London, which was designed by the engineers W.H. Barlow and R.M. Ordish and erected between 1863 and 1876. Constructed of iron and glass, the shed has a total span of 240 feet and it provided a high unobstructed space without visible ties.[12] As one of the great engineering accomplishments of the 19th century, its influence was felt far and wide.

Perhaps of equal significance for the Canadian drill sheds was a modest British design for a similar type of shed by a Royal Engineer named Francis Fowke. Fowke, who had been particularly interested in timber as a cheap and easily-used construction material, developed a new type of semi-circular laminated timber arch. He employed it for the first time in 1858 in the construction of a small drill shed at South Kensington (**figure 3**).[13] At the time the design was seen as a marvel of cheap yet serviceable construction, and it was adopted for a number of drill sheds throughout the country. When Fowke's design techniques were used in the construction of the London International Exhibition Building of 1862, the building was praised for its ingenuity, economy, and simplicity. As one contemporary remarked:

it requires no framing; any person of ordinary intelligence, able to drive a nail could construct the ribs.[14]

This view was similar to the view expressed by Moberly four years later and from it we can infer that, while great strides were being made in the design of iron roof structures in Europe, iron was not available for all public buildings in the 1850s and 1860s.[15] On the contrary, the unpredictable brittleness of cast iron and the relatively high price of wrought iron encouraged research into stronger wooden trusses. There is no evidence that Moberly was directly influenced by Fowke's drill shed design, but we can conclude that engineers working in British North America were well aware of the rapid developments which were taking place in truss and arch design and that, like their European and American counterparts, they were not afraid to experiment.

11 *Ibid.*

12 Carroll L. V. Meeks, *The Railroad Station: An Architectural History* (New Haven and London: Yale University Press, 1956), 84-85.

13 John Weiler, "The Royal Engineers and the Development of Building Technology in the 19th Century" (thesis submitted for the degree of Doctor of Pholosophy, University of York, Institute of Advanced Architectural Studies, September 1987), 306ff.

14 *Ibid.*, 316.

15 Edward Allen, *The Professional Handbook of Building Construction* (John Wiley and Sons: New York, 1985), 322.

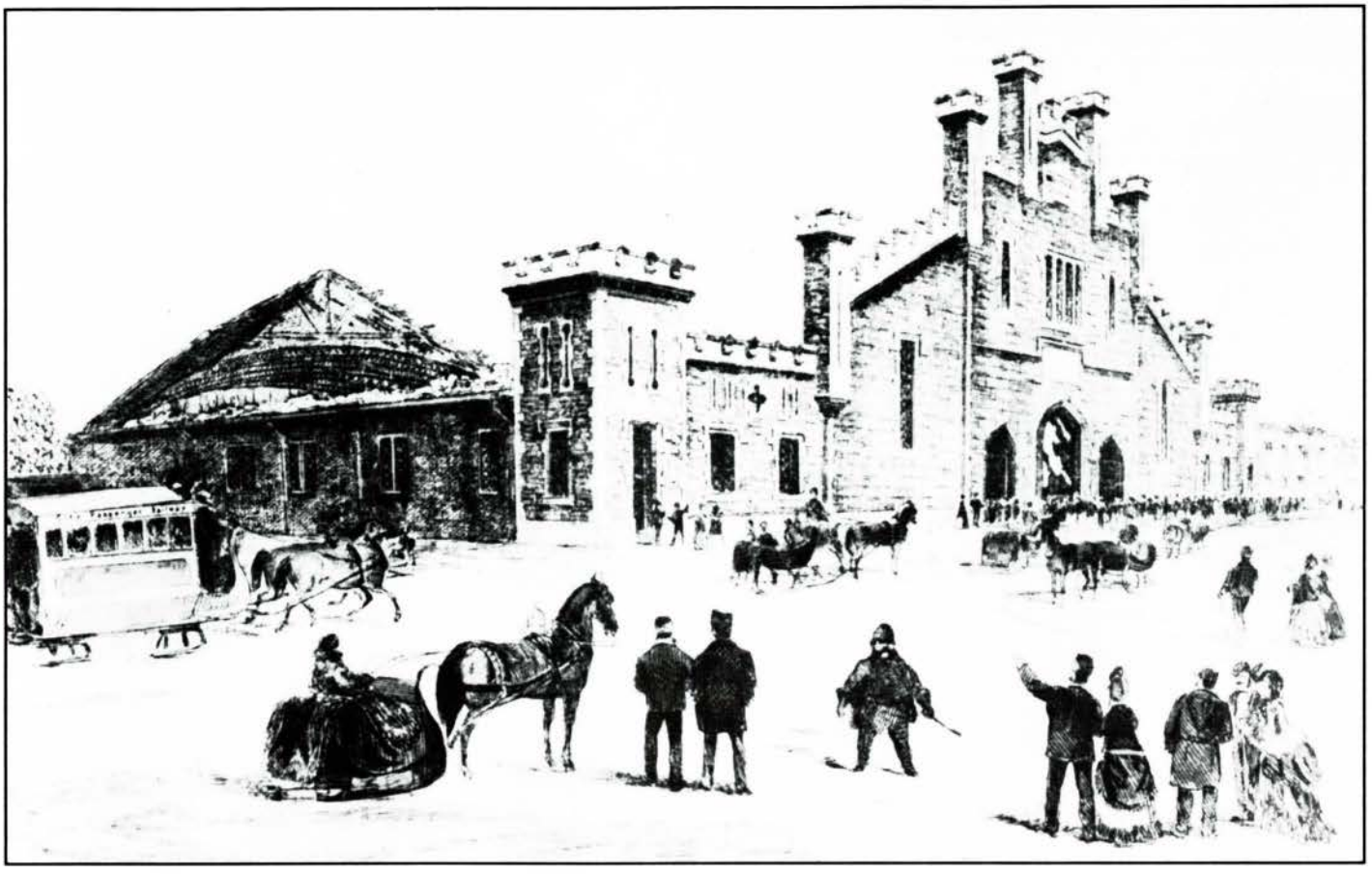


Figure 7. Collapse of the Craig Street Drill Shed roof. (The Canadian Illustrated News, n.d., published in Elinor Kyle Sr, Roots of the Canadian Army: Montreal District 1846-1870 [Montréal: The Society of the Montreal Military and Maritime Museum, 1981], opposite p. 76)

Despite the novelty of Moberly's design, it must be admitted that it was not entirely successful. Shortly after the sheds were erected a number were either blown down or collapsed under the weight of snow. The wooden trusses were not quite strong enough to withstand strong lateral thrusts or great loads. The problem was solved by bracing the arches with an iron tie-rod suspended from the roof by vertical iron hangers; several of these sheds were still standing at the turn of the century (**figure 4**).[16]

A third significant design from the 1860s was the Craig Street Drill Shed in Montreal. In 1867, the local authorities decided to build one large shed for the use of all the city's militia units.[17] Its construction was financed jointly by the city and the militia, aided by a grant from the Department of Militia and Defence. Constructed of stone in a Gothic Revival style, vaguely suggestive of a medieval fortress, the building consisted of a hall lined by individual regimental armouries and storerooms. The hall measured 123 feet wide by 300 feet long.

The structure was covered by a gable roof, which was supported by a wooden Howe truss braced from beneath by a latticed, two-hinged, tied arch. The weight of the arch was carried by the strong lateral walls (**figure 5**). This type of tied arch was used in the construction of a number of railway sheds in the 1850s and 1860s, including The Philadelphia, Wilmington, and Baltimore Depot of 1851-52, which had a span of 150 feet, and Victoria Station in London, 1859-66, which had side-by-side spans of 124 feet each (**figure 6**). A similar roof truss was also employed in the train shed of the Great Western Railway in Toronto, which was built in 1866 and which had a clear span of approximately 70 feet.[18] Alas, unlike these station sheds, the Craig Street Drill Shed had to contend with Montreal winters, and its roof survived for only five years before collapsing in February 1872 (**figure 7**).[19]

DRILL SHEDS OF THE 1870s AND 1880s

Following the withdrawal of British troops in 1872, the defence of the new Confederation fell to the Canadian government. In preparation, the government again purchased new expensive equipment,[20] and the Department of Public Works began to build drill halls in the larger cities where no adequate drill shed existed. The first of these was the Cartier Square Drill Hall in Ottawa. Since all the large drill sheds of the 1860s have now vanished, this building

16 National Archives, RG9, 1C8, Vol. 2, Major Scott, inspector of drill sheds, to Militia headquarters, Ottawa, 15 July 1867. A well-known example of this type of truss was found in the Québec skating rink built in 1877. See Luc Noppen, Claude Paulette, and Michel Tremblay, *Québec: trois siècles d'architecture* (Québec: Libre Expression, 1979), 378.

17 *Department of Militia and Defence*, 1887, xxv.

18 This shed is illustrated in William Dendy, *Lost Toronto* (Oxford and New York: Oxford University Press, 1978), 2.

19 Elinor Kyle Sr, *Roots of the Canadian Army: Montreal District 1846-1870* (Montréal: The Society of the Montreal Military and Maritime Museum, 1981), fig. 30 opposite p. 76.

20 *Department of Militia and Defence*, 1871, 57.

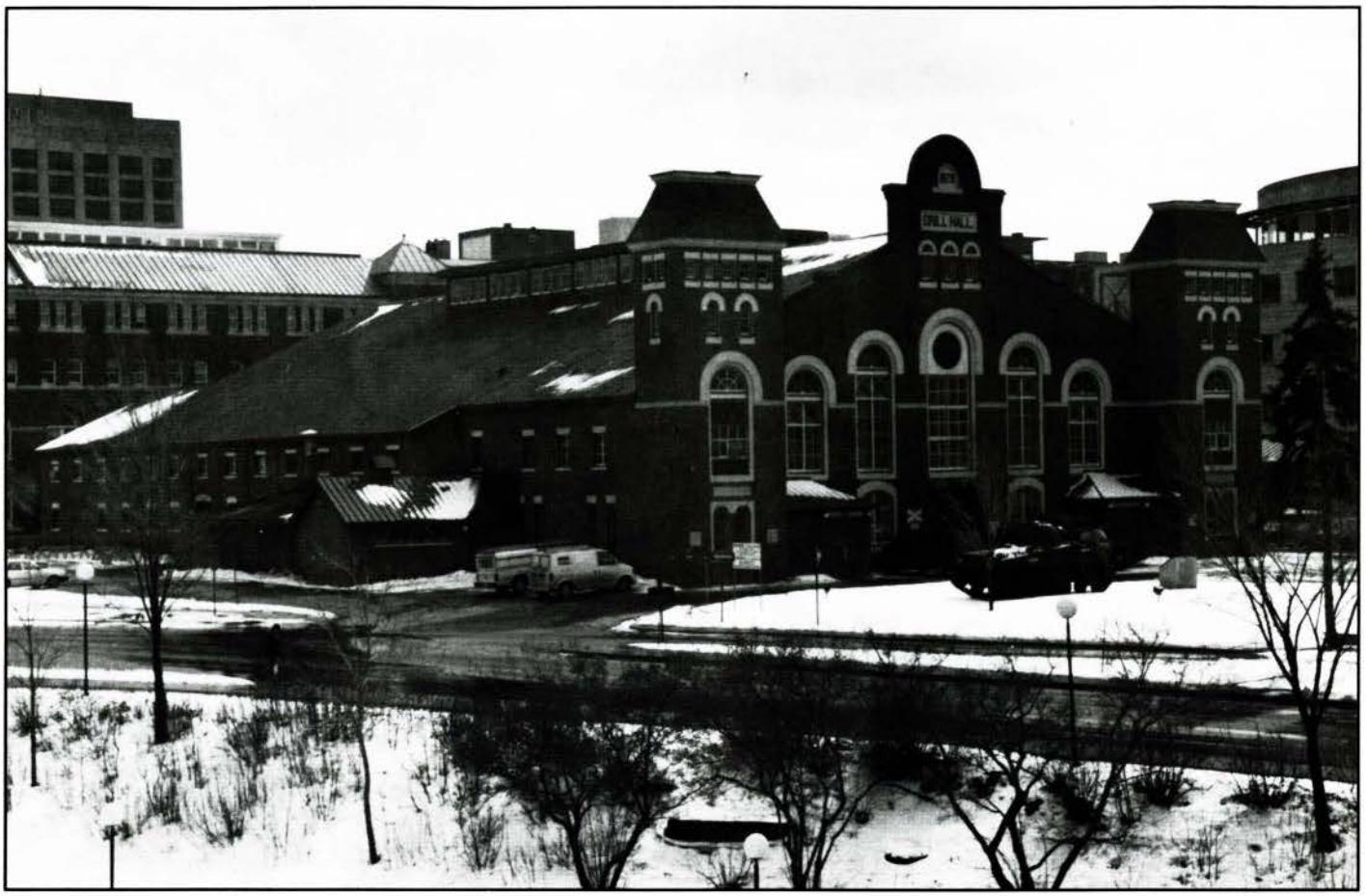


Figure 8 (above). Cartier Square Drill Hall, Ottawa, built in 1879, designed by the Department of Public Works. (M. Trépanier, Canadian Parks Service, 1989)

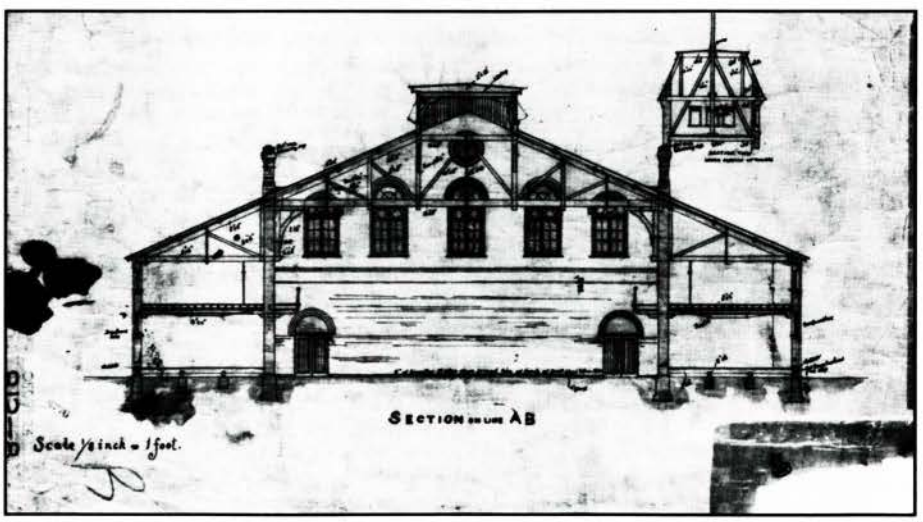


Figure 9 (right). Section through proposed drill shed, Ottawa, 1877. (National Archives, NMC 0019753)

has the distinction of being the oldest extant city drill hall in the country (**figure 8**).

The building measures 75 feet wide by 175 feet long and is two storeys high. In designing its roof structure, the Chief Architect's Branch of the Department of Public Works preferred to rely on a traditional queen-post truss which, because of the wide span, is reinforced with additional struts. The truss is made more efficient by the use of metal plates to join the members of the lower chord or tie beam (**figure 9**). The design of the Cartier Square Drill Hall clearly influenced the design of the second drill hall in Hamilton, which was constructed in 1887 following a fire which destroyed the original building (**figures 10** and **11**).

When work on the Hamilton drill hall began, a spectacular drill hall had just been completed at Québec City. Known as the Grande Allée Drill Hall, it was designed and built

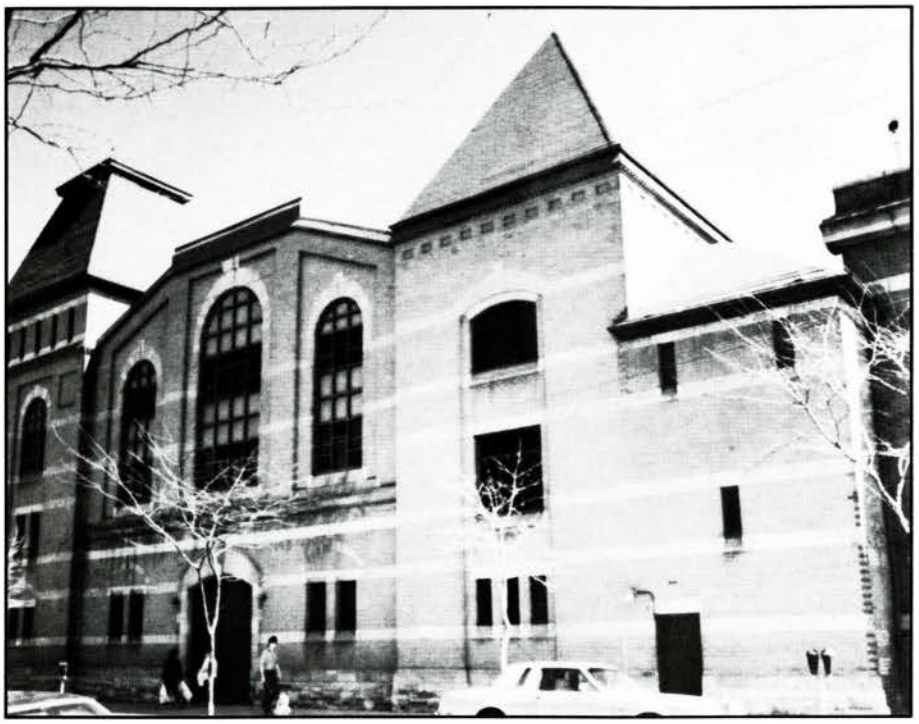


Figure 10 (top left). Hamilton Drill Hall, James Street North, Hamilton, built in 1888, designed by Henry James, architect. (Department of National Defence, 1986)

Figure 11 (middle left). Interior of Hamilton Drill Hall showing trusses. (J. Adell, 1988)

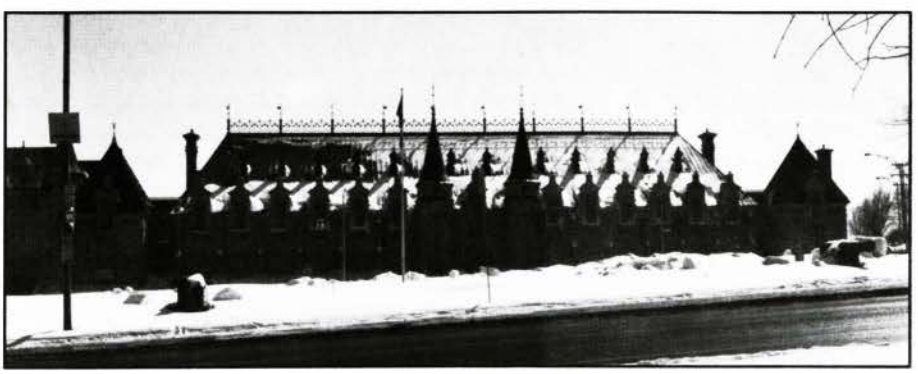


Figure 12 (bottom left). Grande Allée Drill Hall, Québec City, built in 1887, designed by E.E. Taché, architect. (M. Trépanier, Canadian Parks Service, 1989)

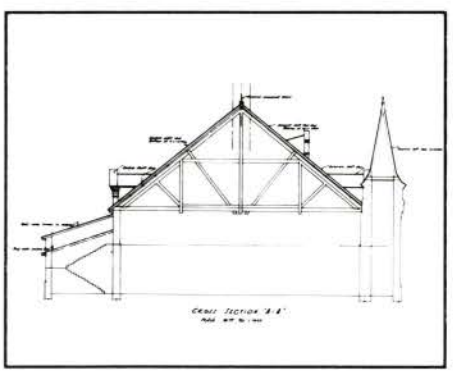


Figure 13 (below). Section through the Grande Allée Drill Hall, Québec, showing the wooden roof truss. (National Archives, RG11M, 77803/39, item 2510)

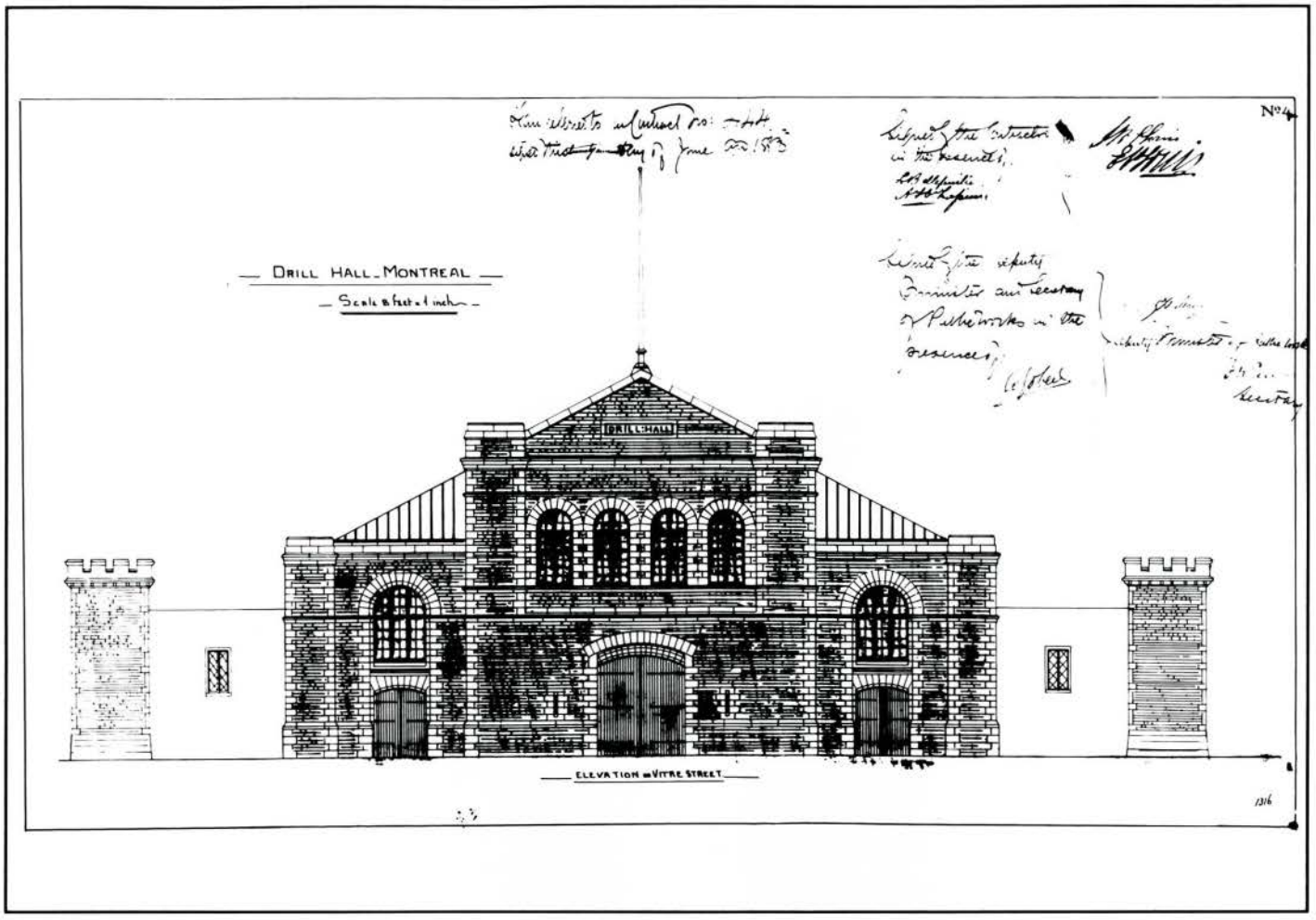


Figure 14 (above). Architectural drawing of the proposed redesign of the Craig Street Drill Shed, Montréal, dated 1883, designed by the Department of Public Works. (National Archives, RG11M, 77802/39, item 2252)

Figure 15 (right). Detail of the roof truss, Craig Street Drill Shed, Montréal. (National Archives, NMC 0025447)

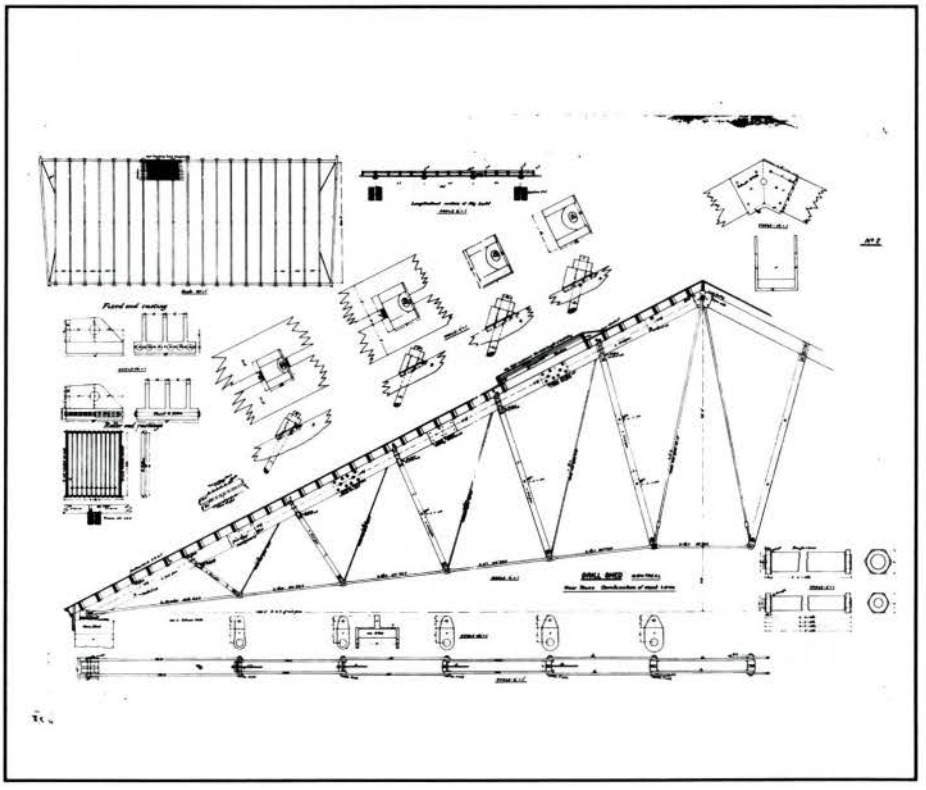


Figure 16. Toronto Armouries, University Avenue and Osgoode Street, Toronto, built in 1893, designed by Thomas Fuller, Chief Architect of the Department of Public Works. Photo taken in 1922. (National Archives, PA 97252)

between 1884 and 1887 for the Department of Militia and Defence by Eugene Étienne Taché, a prominent Québec City architect (**figure 12**). The building, which is notably larger than either the Cartier Square or the Hamilton buildings, measures 96 feet wide by 266 feet long and 65 feet from the floor to the apex of the prominent steep hipped roof. It is one of the earliest examples of a Canadian Chateau Style building, but Taché's creativity did not extend to its structural design, which is quite conservative. By the mid-1880s in Canada compound roofs of iron and timber were occasionally used for larger spans. But combining the two materials required a rather specialized engineering knowledge, and perhaps this persuaded Taché to rely on a tried and true material. His decision may also have been influenced by the fact that the design included an elaborate panelled ceiling above the drill hall. In any event, the roof is supported by a modified queen post truss, which takes up a great volume of space (**figure 13**).

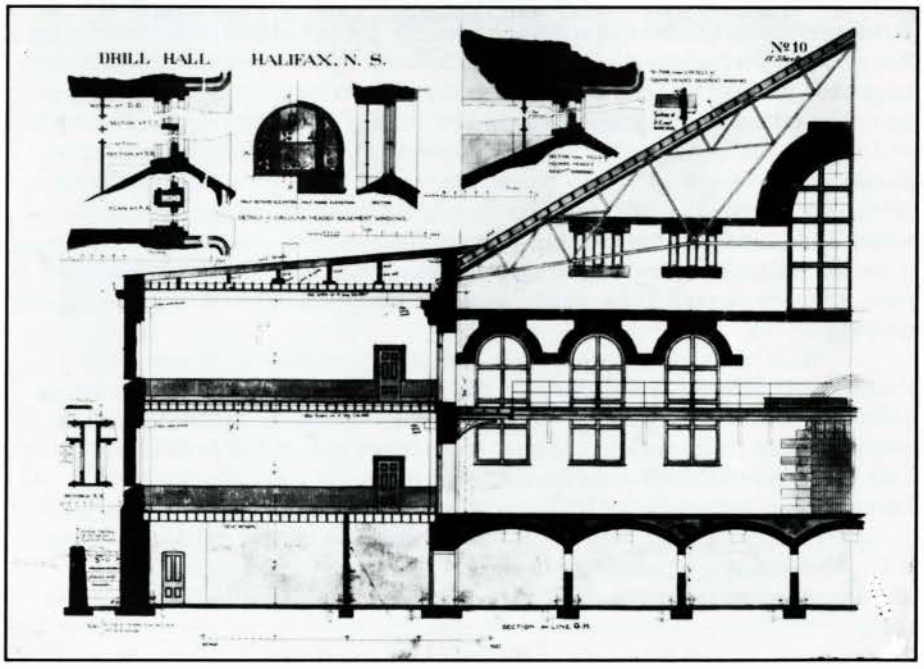
While the Cartier Square, Grande Allée, and Hamilton drill halls were being erected, the Craig Street Drill Shed in Montreal stood in ruins, with the city and the federal government unable to agree on who was responsible for its repair. Eventually the federal government took on the task and with it the design of drill halls entered a new phase. The plans were prepared in 1883 under the supervision of Thomas Fuller, who had been appointed Chief Architect in 1881.[21] The work involved was extensive. The footprint of the building remained the same, but it was decided to enlarge the building by adding a second storey.[22] In addition to rebuilding the structure, Fuller had the outdated Gothic Revival details removed and redesigned the façade in a sombre Romanesque Revival style (**figure 14**).

21 The contract (National Archives, RG11M, 77802/39, item 2232) is dated 27 June 1883.

22 *Department of Public Works*, 1884, xxxiii-xxxiv.

Figure 17 (above). Halifax Drill Hall, 2667 North Park Street, Halifax, built in 1895-97, designed by Thomas Fuller, Chief Architect of the Department of Public Works. (Heritage Recording Services, Canadian Parks Service, 1988)

Figure 18 (right). Architectural sections and details of the Halifax Drill Hall. (National Archives, NMC 0018711)



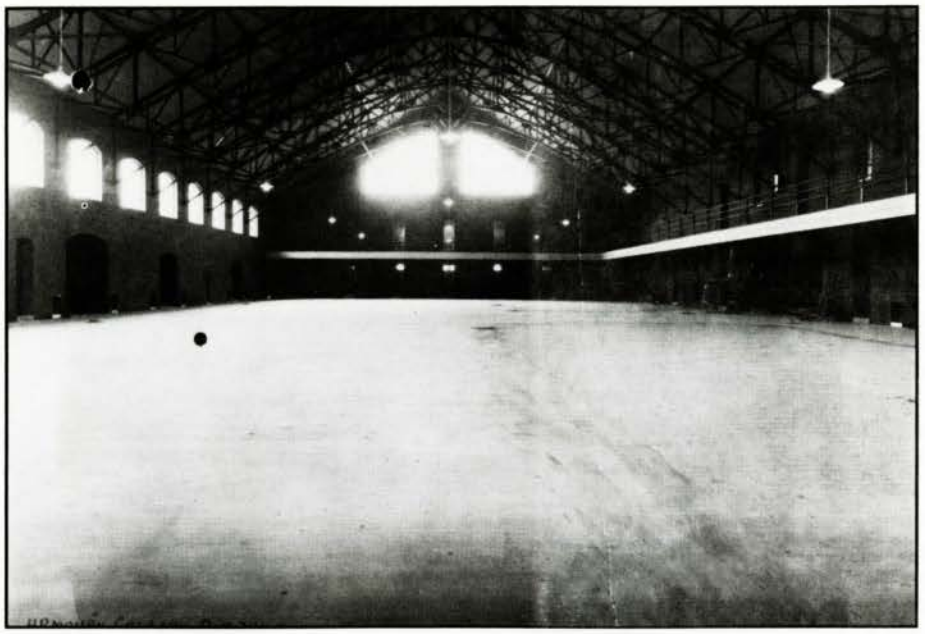


Figure 19. Mewata Drill Hall, Calgary: view of the interior in 1918 showing the steel trusses. (National Archives, PA 53022)

Faced with roofing an uninterrupted space of 123 feet, the Department of Public Works had no alternative but to use an engineering truss. The type chosen was a combination wood and iron truss, which was manufactured by a Montreal company. The lower chord was made up of short iron rods bolted together to permit the centre of the chord to be raised above the springing (**figure 15**).[23] By comparison with the largest contemporary American armoury, the New York Seventh Regiment Armoury (1878-80), which had a drill hall 187 feet wide spanned by an iron arch,[24] the span of the Craig Street Drill Shed was not spectacular, but it was still one of the largest unencumbered interior spaces in Canada.[25] More significantly, this time the roof did not collapse. In 1939-40 the drill shed was largely rebuilt and given a structural steel frame.[26] It continued to function as a drill hall for many years before being demolished in the 1970s.

DRILL SHEDS OF THE 1890s

The size and the style of the Craig Street Drill Shed became the model for two important drill halls designed by Thomas Fuller: the Toronto Armouries of 1893, since demolished, and the Halifax Drill Hall of 1895 (**figures 16** and **17**). The two buildings were the first drill halls to have steel roof trusses and, more precisely, steel Fink trusses, whose designs were not dissimilar to the wooden trusses of the first Hamilton shed (**figure 18**). The Halifax building, which still functions well, measures 304 feet by 160 feet and has a hall span of 110 feet. In addition to the hall and the armouries, the building contains a shooting range in the basement, a lecture room, library, recreation facilities, and mess rooms. Together with the Toronto building, it was the first drill hall to be equipped with electric lighting and modern washrooms. In short, the building functioned as a fully equipped training centre and recreational club.[27]

CONCLUSION

The Halifax Drill Hall represents the final evolution of a building type which began in the 1860s with the construction of the first temporary sheds. In that early phase, railway engineers were called upon to solve the structural problem possed by the need for an unusually wide unobstructed space. In the 1870s, the federal government took over the design of the buildings, and the experimental nature of the early designs was replaced by a much more conventional building type. Their size was controlled by the return to the heavy timber truss. It was only in the 1880s and 1890s, with the introduction of iron and steel roof trusses, that the structural constraints were removed and the building type finally came into its own (**figure 19**). Once arrived at, the structural design of the drill hall remained unchanged until the 1930s, when reinforced concrete roofs once more challenged the skill of the engineers.

23 Information taken from the sectional drawings (National Archives, RG11M, 77803/39, item 2304).

24 Robert Koch, "The Medieval Castle Revival: New York Armories," *The Journal of the Society of Architectural Historians* 45 (October 1955): 24.

25 Eric Arthur, *Toronto: No Mean City* (Toronto, Buffalo and London: University of Toronto Press, 1968), 188.

26 *Department of Public Works*, 1940, 24; 1941, 25.

27 *Department of Public Works*, 1895, 26.

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